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Instruction Manual
68P80103W09-A

SAFE HANDLING OF CMOS INTEGRATED-CIRCUIT DEVICES

Many of the integrated-circuit devices used in communications equipment are of the complementary metal oxide semiconductor (CMOS) type. Because of their high open-circuit impedance, CMOS IC's are vulnerable to damage from static charges. Everyone involved in handling, shipping, and servicing them must be extremely careful not to expose them to such damage.

CMOS IC's do have internal protection, but it is effective only against overvoltages in the hundreds of volts, such as those that could occur during normal operations. Overvoltages from static discharge can be in the thousands of volts.

When a CMOS IC is installed in a system, the system's circuit elements distribute static charges and load the CMOS circuits. This decreases the vulnerability of the IC's to static discharge, but improper handling will probably cause static damage even when the IC's are so installed.

To avoid damaging CMOS IC's, take the following precautions when handling, shipping, and servicing them.

1. Before touching a circuit module, particularly after having moved around in the service area, touch both hands to a bare metal, earth-grounded surface. This discharges any static charge you may have accumulated.

NOTE

Wear a conductive wrist strap (Motorola Part No. RSX-4015A) to minimize the buildup of static charges on your person while you are servicing CMOS equipment.

WARNING

When wearing a conductive wrist strap, be careful near sources of high voltage. By grounding you thoroughly, the wrist strap also increases the danger of lethal shock from accidental contact with such a source.

2. Whenever possible, avoid touching any electrically conductive parts of the circuit module with your hands.
3. Check the INSTALLATION and MAINTENANCE sections of the service manual and the notes on the schematic to find out whether or not you can insert or remove circuit modules with power applied to the unit, and act accordingly.
4. When servicing a circuit module, avoid carpeted areas, dry environments, and the wearing of static-generating clothing.
5. Be sure that all electrically powered test equipment is grounded. Attach the ground lead from the test equipment to the circuit module before connecting the test probe. Similarly, disconnect the test probe before removing the ground lead.
6. When you remove a circuit module from the system, lay it on a sheet of aluminum foil or other conductive surface connected to ground through 100,000 ohms of resistance.

WARNING

If the aluminum foil is connected directly to ground, you may get a shock if you touch it and another electrical circuit at the same time.

7. When soldering, be sure the soldering iron is grounded.
8. Before connecting jumpers, replacing circuit components, or touching CMOS pins (if this becomes necessary during the replacement of an integrated-circuit device), be sure to discharge any static buildup on your person (see Procedure 1, above). Because you can have a voltage difference across your body, you should use only one hand if you must touch the board wiring or any of the pins on the CMOS device.
9. When replacing a CMOS integrated-circuit device, leave the device in its metal rail container or conductive foam until you are ready to insert it into the pronged circuit module.
10. Connect any low-impedance test equipment such as a pulse generator to CMOS device inputs after you have applied power to the CMOS circuitry. Similarly, disconnect such low-impedance equipment before turning off power.
11. Wrap CMOS modules in conductive material when transporting them from one area to another, even within the same room. Use wrapping material similar to that in which replacement modules are wrapped when they arrive from the factory. (You can also use aluminum foil.) Never use nonconductive material for packaging these modules.

MODEL CHART FOR SYSTEMS 9000
DIRECT ENTRY KEYBOARD

MODEL										DESCRIPTION
W983AA										DEK for MDC-600 Status
	W984AA									DEK for MDC-600 Status/Message
		W736AA								DEK for MDC-1200 Smart Status/Message, 8 Mode
			W738AA							DEK for MDC-1200 Smart Status/Message, 16 Mode
				W370AA						DEK for Conventional MDC-1200 Status/Message
					W370AB					DEK for MDC-1200 Status/Message, 8 Mode
						W941AC				DEK for Conventional MDC-1200 Status/Message
							W941AD			DEK for MDC-1200 Status/Message, 16 Mode
								W374AA		DEK for MDC-1200 Status/Message
									W365AB	DEK for Trunked MDC-1200 Status/Message
										ITEM / DESCRIPTION
◆	◆	◆	◆		◆		◆			HCN1063B — Control Unit, Systems 9000E
				◆		◆		◆	◆	HLN1304A — MDC-1200 Option for 9000E
◆	◆									HLN4902B — MDC Signalling for Systems 9000
◆	◆	◆	◆		◆		◆			HLN4991A — EEPROM for 64 Mode Operation
◆	◆									HLN5133C — MDC-600 Systems 9000 Software
◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	HKN4273A — DEK Cable Hardware
◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	HLN5157A — DEK Mounting Hardware
◆	2	◆	2	◆	◆	2	2	2	◆	HLN5158C — DEK Board
◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	HLN5159A — DEK Status Housing and Hardware
◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	HLN5330A — Status DEK Spare Buttons
	◆		◆			◆	◆	◆		HLN5211A — Message DEK Housing and Hardware
		◆	◆							HLN5340A — Status/Message Custom Buttons
		◆	◆		◆		◆			HLN5317A — MDC-1200 Controller Card
		◆	◆							HLN5418A — MDC-1200 SmartStatus Software
				◆		◆				HLN5318A — MDC-1200 Software
		◆			◆		◆			68P80102W07 — Systems 9000 MDC-1200 Instruction Manual
◆	◆									68P80101W15 — MDC-600 Signalling Instruction Manual
◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	68P80103W09 — Direct Entry Keyboard Instruction Manual

MAEPF-22508-O

CODE: ◆ = ONE ITEM SUPPLIED
2 = NUMBER OF ITEMS SUPPLIED

MODEL CHART FOR MAXTRAC™ RADIOS WITH DIRECT ENTRY KEYBOARD

MODEL					DESCRIPTION
B941AB					DEK for Status
	B944AB				Status/Message Buttons for DEK
		B979AA			DEK for Status/Message
			B980AB		DEK for Outbound Message
				ITEM	DESCRIPTION
●				HLN1320C	DEK Status/Message Unit
		●		HLN1321C	DEK Status Unit
			●	HLN1322C	Status/Message Control Head
●		●		HLN5330A	Spare Buttons
	●			HLN5340A	Status/Message Custom Buttons
		●	●	HKN4273A	DEK Cable Hardware
●				HKN4373A	DEK Cable Hardware
		●	●	HLN5157A	DEK Mounting Hardware
●		●	●	HLN5158C	DEK Circuit Board
●		●		HLN5513B	DEK Status Housing and Hardware
			●	HLN5516B	Status/Message Housing and Hardware
●				HLN5553A	DEK Mounting Hardware

CODE: ● = ONE ITEM SUPPLIED

MMXW-7903-O

MODEL CHART FOR SPECTRA® AND SPECTRA® 9000 RADIOS DIRECT ENTRY KEYBOARD

MODEL													DESCRIPTION
W599AX													DEK for Spectra 8 Mode
	W614AL												DEK for Spectra 16 Mode
		W615AQ											DEK for Spectra 24 Mode
			W269AN										Siren/PA for SYNTOR X 9000E
				W269AX									Siren/PA for Spectra 9000
					W269BB								Siren/PA for Spectra
						W365AC							DEK for Spectra 9000, 8 Status/1 Message
							W365AE						DEK for Spectra, 8 Status/1 Message
								W374AB					DEK for Spectra 9000, 8 Status/8 Message
									W374AD				DEK for Spectra, 8 Status/8 Message
										W589AR			Public Address for SYNTOR X 9000E
											W589AV		Public Address for Spectra 9000
												W589AX	Public Address for Spectra
												ITEM	DESCRIPTION
			♣	♣	♣					♣	♣	♣	68P80101W10 Systems 9000 Siren/PA Instruction Manual
♣	♣	♣	♣	♣	♣	♣	♣	2	2	♣	♣	♣	HKN4273A DEK Cable Hardware
										♣	♣	♣	HLN1238B DEK for Siren/PA
										♣	♣	♣	HLN1239C DEK Siren/PA Assembly
			♣	♣	♣								HLN1240B DEK for Siren/PA
			♣	♣	♣								HLN1241C DEK Siren/PA Assembly
♣	♣	♣	♣	♣		♣		2		♣	♣		HLN5157A DEK Mounting Hardware
♣	♣	♣	♣	♣	♣	♣	♣	2	2	♣	♣	♣	HLN5158C DEK Circuit Board
						♣	♣	♣	♣				HLN5159A DEK Status Housing and Hardware
								♣	♣				HLN5211A DEK Message Housing and Hardware
										♣	♣	♣	HLN5269A Blank Buttons
										♣	♣	♣	HLN5270A DEK Housing and Hardware
			♣	♣	♣								HLN5280A DEK Housing and Hardware
						♣	♣	♣	♣				HLN5330A Spare Buttons
			♣	♣	♣								HLN5331A Spare Buttons
					♣		♣		2			♣	HLN6275A DEK Hardware Kit
♣	♣	♣											HLN6320A Spare Plugs
		♣											HLN6323A DEK 17-24 Mode Housing and Hardware
	♣	♣											HLN6322A DEK 9-16 Mode Housing and Hardware

MAEPF-22160-O

CODE: ♣ = ONE ITEM SUPPLIED
2 = NUMBER OF ITEMS SUPPLIED

NOTES

I. INTRODUCTION

The Direct Entry Keyboard (DEK) unit is designed for use with the MDC-600™ Signalling, MDC-1200™ Signalling, or trunking options. The DEK provides pre-programmed assignment of pushbuttons for status or status/message selection to your SYNTOR X 9000, Spectra, Spectra 9000, or MaxTrac radio, thus eliminating the need to scroll through choices while in the configuration mode.

A. SYNTOR X 9000/Spectra/Spectra 9000 Radios

The DEK unit contains eight momentary pushbuttons with indicators. A maximum of three DEK units can be used with one control unit or radio. The functions of the individual pushbuttons are selected by the field programmer.

The DEK gives you option button control of status and/or message transmission. To transmit a status code or status/message code, without a DEK unit, you must press and hold the appropriate button on the control unit to enter the configuration mode, scroll to the desired code using the **Mode** rocker, then press the **HOME** button to send the selected code. With a DEK unit you simply press the button assigned to the code you wish to transmit and the code transmits in the normal manner.

B. MaxTrac Radios

The DEK unit mounts either above the MaxTrac radio or separately and contains eight momentary pushbuttons with indicators. A maximum of three DEK units can be used with one radio. The functions of the individual pushbuttons are selected by the field programmer. The DEK gives you control of status and/or message transmissions as well as reception of dispatcher initiated messages (outbound messages).

II. STATUS SELECTION

A. SYNTOR X 9000/Spectra/Spectra 9000 Radios

The desired status codes are programmed into the radio EEPROM with the field programmer. To transmit your selected status, press the corresponding status button on the DEK unit.

The receiving signalling console automatically acknowledges when the mobile radio makes a status transmission. The mobile unit receives this acknowledgement by sounding short tones. Should the mobile unit not receive the base's acknowledgement, the unit retransmits the status automatically a maximum of four more times, or until the unit receives an acknowledgement from the base. If the mobile unit still does not receive the acknowledgement from the base, a low tone sounds and the display shows “NO ACK” (no acknowledgement) for three seconds.

B. MaxTrac Radios

After the status is sent, the red indicator blinks while waiting for an acknowledge. When an acknowledge is received, four chirp tones sound and the status indicator lights solid. This shows the last status acknowledged by the dispatch terminal.

If an acknowledge is not received, the red indicator stops flashing and is turned off. A low tone “bonk” sounds indicating that the status was not acknowledged.

III. MESSAGE SELECTION

A. SYNTOR X 9000/Spectra/Spectra 9000 Radios

In addition to the DEK unit for status transmissions, an additional DEK unit for message selections may be ordered. You assign each code a name or function for conditions you determine. Assignment is made by programming the EEPROM with the field programmer. To transmit your selected message, press the corresponding message button on the DEK unit.

The receiving signalling console automatically acknowledges when the mobile radio makes a message transmission. The mobile unit receives this acknowledge by sounding short tones. Should the mobile unit not receive the base's acknowledgement, the unit retransmits the message automatically a maximum of four more times, or until the unit receives an acknowledgement. If the mobile unit still does not receive the acknowledgement from the base, a short beep sounds and the display shows “NO ACK” (no acknowledgement for three seconds.

B. MaxTrac Radios

After the message is sent, the red indicator light blinks while waiting for an acknowledge. When an acknowledge is received, four chirp tones sound and the message indicator lights solid. This shows the last message acknowledged by the dispatch terminal.

If an acknowledge is not received, the red indicator stops flashing and is turned off. A low tone “bonk” sounds indicating that the message was not acknowledged.

C. MaxTrac Outbound Message Reception

When a dispatcher initiated message is received by the MaxTrac radio, the red indicator corresponding to the received message blinks and four chirp tones sound every five seconds. A momentary press of the corresponding button causes the red indicator to light solid while an extended press turns off the indicator.

IV. THEORY OF OPERATION

This discussion of the theory of operation for the DEK circuitry consists of four sections: the control unit interface, inputs to the option, keypad interface, and the common circuits section.

A. Control Unit Interface

The control unit microprocessor provides the CLOCK, STROBE, DATA OUT, and DATA IN lines required for DEK operation.The microprocessor services the DEK at 20 millisecond intervals. This service routine consists of a strobe pulse, 32 clock cycles, and a serial output data stream consisting of four 8-bit words. The control unit microprocessor reads the input data stream, which also consists of four 8-bit words. Switched B+ supplies DEK power.

B. DEK Input Section

The input section consists of two CMOS 8-bit shift registers, U1 and U2. These shift registers convert the serial data into parallel data. The parallel data controls indicator and background LEDs. The service routine begins with a strobe pulse that latches the previous data onto U1 and U2's output latches. The clock then cycles 32 times to propagate the data through the shift registers.

The first two 8-bit data words are passed on to the next DEK option. They perform the same functions as the last two words in the second DEK option. If this option is not present, then its data is ignored.

The last 8-bit word controls the eight indicator LEDs. The first three bits of the third 8-bit word control the “new” VIP output port located on the DEK option. When the next bit is set low, it blanks indicators and background LEDs. The last three bits control the indicator LED's brightness.

A dual monostable multivibrator, U3, controls brightness. U3B functions as a pulse generator retriggered by R26 and C3. U3A is triggered from this pulse. Duration is controlled by the timing resistor switched in by the last three bits in the third word. The output of U3A drives the output enable line of U1 to pulse the indicator LEDs. The pulse duration determines the brightness level of the LEDs.

C. DEK Keypad Interface

The keypad interface uses two 8-bit CMOS static shift registers, U4 and U5. These registers perform parallel to serial data conversion. When the strobe line goes high, the keypad data is loaded into U4. This comprises the first 8-bit data word. U5 is loaded with three new VIP inputs which makes the second data word. The data is then serially shifted out on clock transitions through the DATA IN line. The control unit microprocessor then reads this data for VIP and DEK keypad activity. The last two input data words are created by the second DEK option, if present.

D. Common DEK Circuitry

VR9 is a high precision zener diode. Together with R59, they provide a 5.6 volt reference to Q17. The transistor provides the regulated 5-volt supply for the DEK option.

A series resistor and a shunt zener diode, R18 and VR1 for example, are placed on all lines external to the DEK option to protect the internal circuitry from electrostatic discharge. During power up, R60 and C8 disable U1 to prevent erroneous displays.

V. SYNTOR X 9000/SPECTRA 9000/SPECTRA REMOTE INSTALLATION

A. General

The DEK mounts independently or stack mounts with the radio system control unit, (see Figures 1 and 2). Each DEK unit comes with a standard mounting trunnion for independent mounting, two stacking brackets for stack mounting, and two wing screws. A maximum of three DEK units may be mounted with a single control unit.

B. DEK and Control Unit Mounting

Be sure the power switch on the control unit is off. Remove the vehicle interface port (VIP) connector from the rear of the control unit. Install the VIP end of a DEK interface cable in its place.

The VIP lines that were in the control unit VIP connector must be rewired for the DEK VIP II connector. Connect the other end of the DEK interface cable to the center of the DEK unit's connector. If a second DEK unit is used, connect the VIP end of the second DEK interface cable to the VIP connector of the first DEK. Connect the other end to the center of the second DEK unit's connector.

C. SYNTOR X 9000 and Spectra 9000 Control Units

Attach the stacking bracket to the DEK using the two wing screws from the DEK kit. Remove the wing screws from the control unit. Position the DEK above the control unit and align the DEK brackets with the trunnion mounting holes. Insert the control unit's wing screws through the mounting holes and attach the control unit. Before you tighten the wing screws, adjust the angle of the DEK and control unit within the trunnion. If a second or third DEK unit is used, mount it in the same manner above for the first DEK unit.

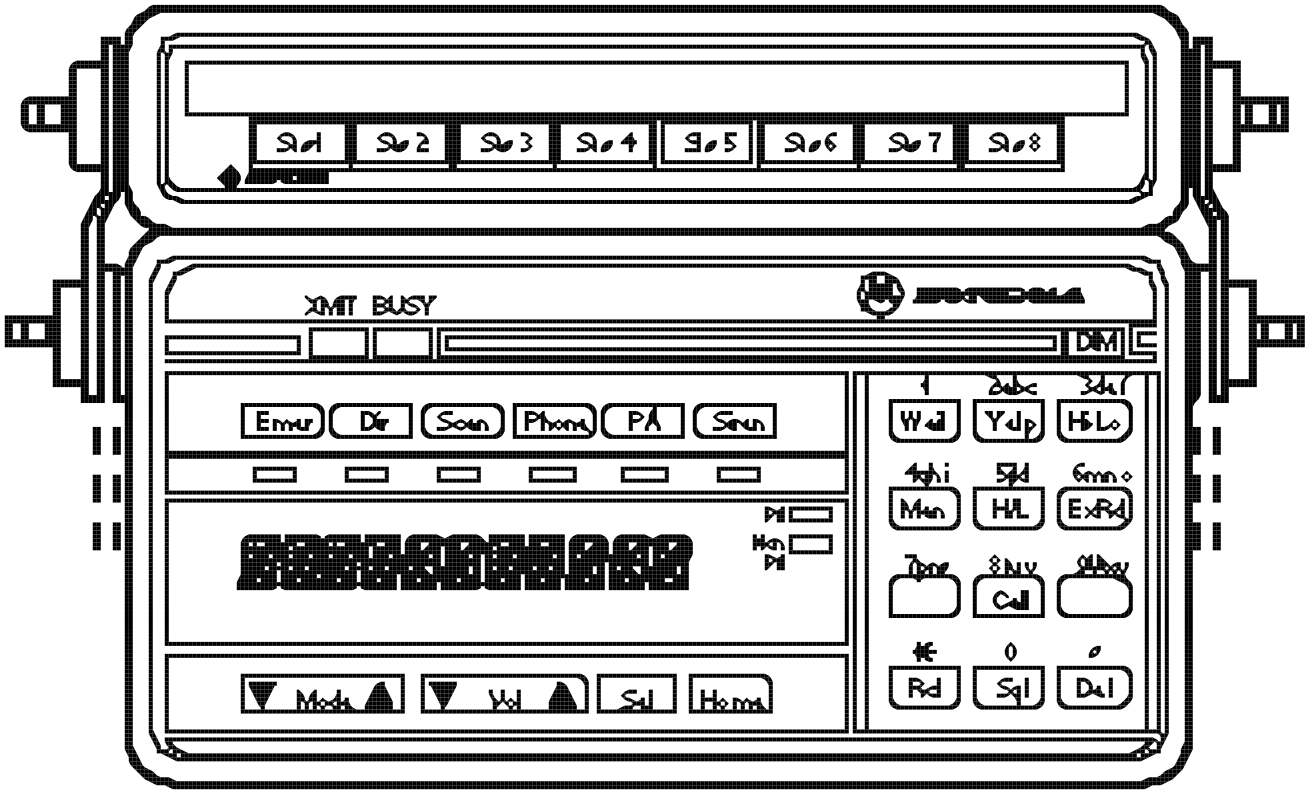

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Figure 1. SYNTOR X 9000 and Spectra 9000 Control Unit with Direct Entry Keyboard

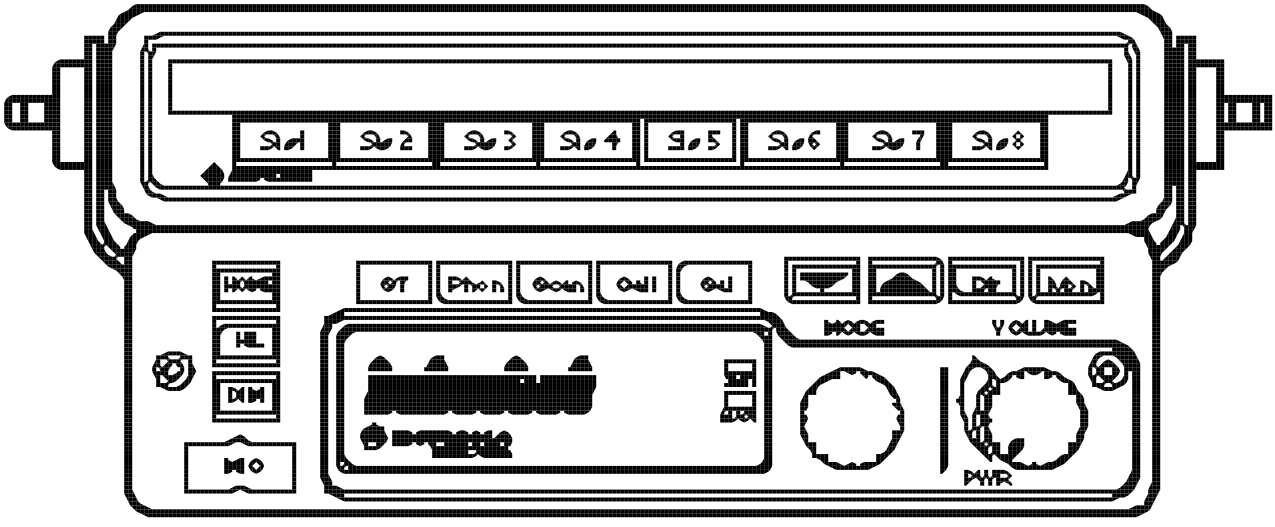

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Figure 2. Spectra Rotary Control Unit with Direct Entry Keyboard

D. Spectra Remote Control Heads

(See Figure 4)

Attach the adapter brackets to the control head mounting trunnion with flat washers, split ring lockwashers, and M5x16mm long torx screws. Attach the DEK box to the adapter brackets using wing screws. If desired, you may stack up to three DEK boxes using the stacking brackets for the top two DEK units.

VI. MAXTRAC INSTALLATION

A. General

The B941 Status/Message Direct Entry Keyboard (DEK) Option stack mounts with the MaxTrac radio. (See Figure 3). An additional status/message DEK (B979) and an outbound message DEK (B980) require the use of a B941 Status DEK and can be independently mounted or stacked above the status DEK.

The B941 DEK comes with a stacking bracket while the other DEK units come with a standard mounting trunnion for independent mounting, two stacking brackets for stack mounting, and two wing screws. A maximum of three DEKs can be stack mounted together.

B. Mounting The Status/Message DEK (B941)

To mount the B941 DEK to the radio, first be sure the MaxTrac radio's power switch is off. Attach the stacking bracket to the B941 DEK using two wing screws from the supplied hardware kit. Remove and discard the wing screws from the radio and align the stacking bracket with the trunnion mounting holes. Insert the remaining two wing screws from the supplied hardware kit through the stacking bracket holes and into the trunnion mounting holes. Attach the radio to the trunnion. Before you tighten the wing screws, adjust the angle of the radio within the trunnion.

C. Installing DEK-To-Radio Cable

The HKN4373A Cable connects the status/ message DEK with the MaxTrac radio. Before installing this cable, first be sure the MaxTrac radio's power switch is off. Connect the overmolded connector to the male connector on the back of the status/message DEK. Connect the other end of the cable to the 16-pin male options connector on the back of the MaxTrac radio.

D. Installing Additional DEK(S)

An additional status/message DEK and/or outbound message DEK can connect to the B941 status/message DEK. The additional DEK(s) can be independently mounted or stack mounted with the status/message DEK.

To mount the additional DEK(s) independently, select an appropriate location near the status/message DEK and within reach of the HKN4273A cable. Use the mounting trunnion as a template to mark the mounting hole locations. When drilling the holes be careful not to damage any wires or other vital parts. Mount the trunnion with the supplied screws and attach the DEK to the trunnion with the two wing screws.

To stack mount the additional DEK(s) to the status/message DEK, first be sure the MaxTrac radio's power switch is off. Attach the stacking bracket to the DEK using the two wing screws from the status/message DEK and align the stacking bracket with the trunnion mounting holes. Insert the status/message DEK's wing screws through the adapter holes and into the trunnion mounting holes and attach the status/message DEK to the trunnion. Before you tighten the wing screws, adjust the angle of the DEKs within the trunnion. If an additional DEK is used, mount it in the same manner to the other DEK.

E. Installing DEK-To-DEK Cable

The HKN4273A Cable allows the additional DEK(s) to be daisy chained to the B941 status/message DEK. To install the HKN4273A Cable, connect the overmolded end to the male connector on the back of the additional DEK. Connect the other connector to the male connector on the back of the status/message DEK (or the second DEK if using three DEKs).

F. DEK Button Replacement

To replace the standard **Sts** buttons (or to change **Sts** to **Msg** buttons), perform the following steps.

1. Use a pair of needle nose pliers to gently grasp the top and bottom edges of the button to be replaced.
2. Carefully rock the button up and down while pulling on the button to remove the button from the housing.
3. Line up the replacement button with the empty location in the housing and firmly press the button into place.

GPW-7904-O

Figure 3. MaxTrac Radio System with Status/Message DEK

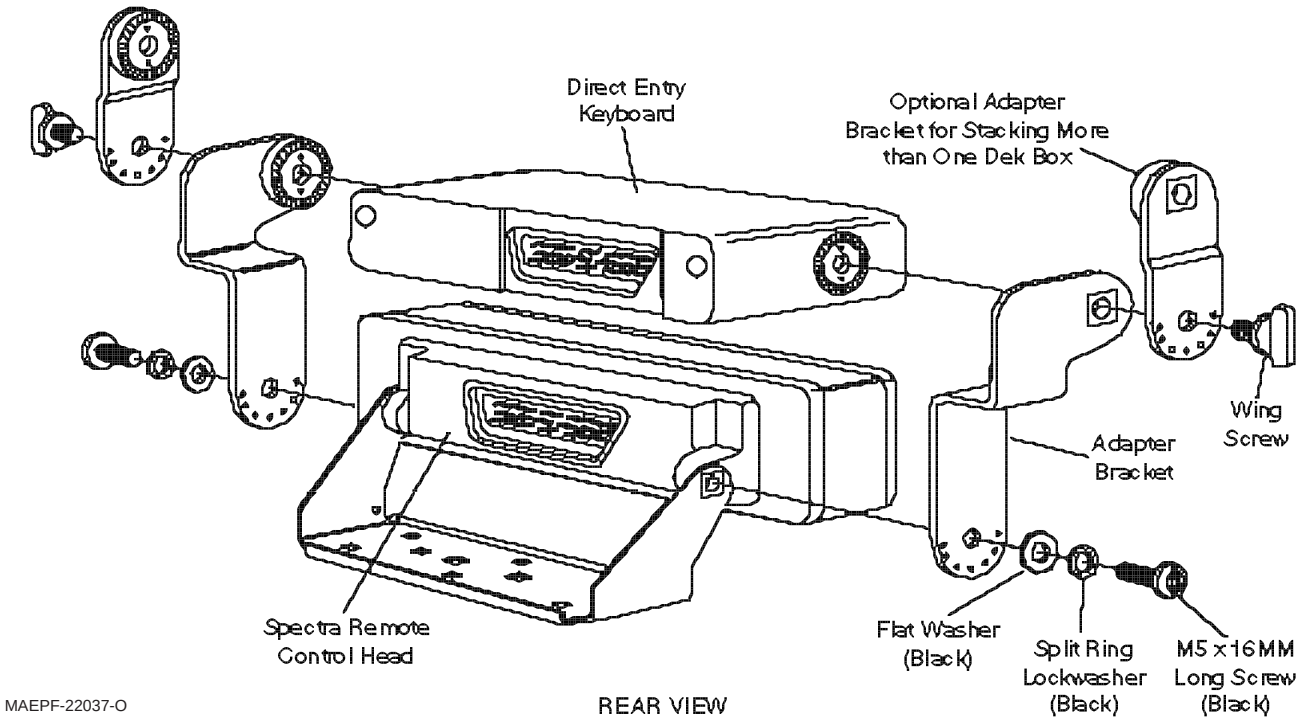


Figure 4. Mounting the Direct Entry Keyboard to the Spectra Remote Control Head

VII. MAINTENANCE AND TROUBLESHOOTING

A. Systems 9000™ Radios

Connect the DEK option to a working control unit using the DEK cable assembly to test the DEK circuitry. To check for proper status or status/message operation requires an MDC-600 or MDC-1200 option board for Systems 9000 radios. Ensure both the radio and control unit are properly programmed for the DEK as well as the signalling option being used for the radio system.

B. MaxTrac Radios

To test the DEK circuitry, connect the DEK to a working MaxTrac Trunked radio using the DEK cable assembly. With the radio properly programmed for the DEK, place the radio in the TEST mode (see the MaxTrac Service Manual). When a DEK button is pressed, the corresponding LED lights solid and a good chirp tone sounds.

C. Troubleshooting Charts

Use the troubleshooting charts on the following pages to isolate malfunctions attributed to the DEK option. Each chart's logical sequence of steps helps isolate the problem to a faulty component or circuit.

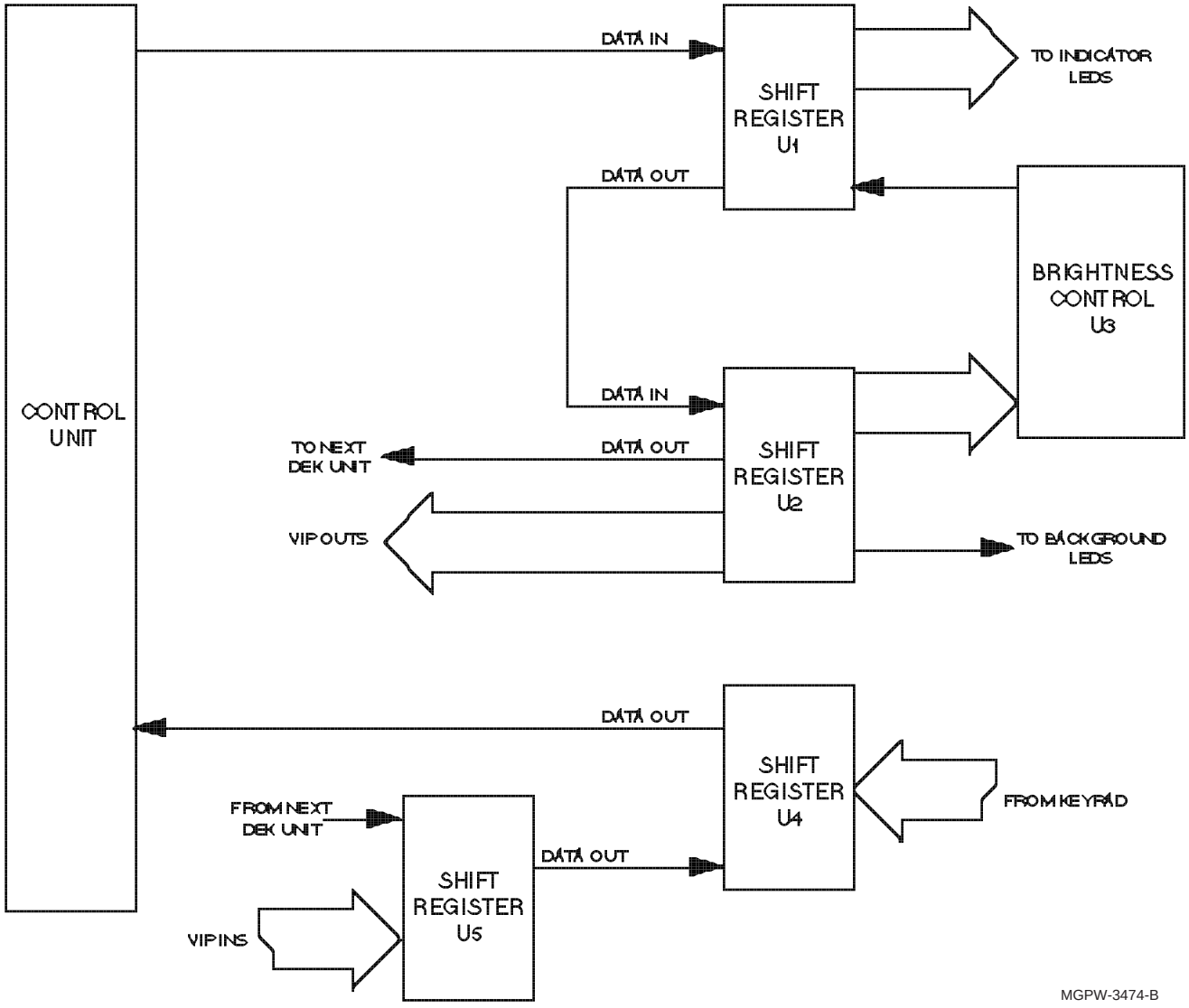
D. DEK Programming for Systems 9000

An IBM® personal computer and control unit/radio programming software (version 2.0 or later) are required to program the DEK option.

An external emergency switch that is programmed for use with a DEK unit does NOT activate the emergency feature if the DEK interface cable is disconnected. Be sure the interface cable is attached properly.

E. DEK Programming MaxTrac

An IBM personal computer and MaxTrac Trunked Radio Service Software (version 4.0 or later) are required to program the DEK option.



FUNCTIONAL BLOCK DIAGRAM FOR DIRECT ENTRY KEYBOARD

INSERT EXPLODED VIEW
GPW-3402-C

HLN5330A Spare Buttons for DEK **MXW-4506-A**

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	38-80156L42	message button 1
	38-80156L43	message button 2
	38-80156L44	message button 3
	38-80156L45	message button 4
	38-80156L46	message button 5
	38-80156L47	message button 6
	38-80156L48	message button 7
	38-80156L49	message button 8

Direct Entry Keyboard
Mechanical Exploded View **MXW-3403-D**

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	- - - - -	pushbutton, 8 used (p/n depends on legend)
2	15-80150L01	front cover
	15-80150L03	front cover
3	32-80243L01	housing gasket
4	75-80151L01	keypad
5	43-80153L01	LED spacer, 2 used
6	03-10945A11	tapping screws, 5 used
7	28-80245L01	50 pin connector
8	03-80160E01	wing screw, 4 used
9	07-80217L01	trunnion adapter bracket, 2 used
10	43-80127J01	trunnion spacer, 4 used
11	15-80212L01	VIP connector housing
12	30-80248L01	interface cable
13	43-80282J10	nameplate
14	03-10908A33	machine screw, 2 used
15	15-80055L01	back housing
	15-80055L01	back housing
16	32-80137L01	D connector gasket
17	32-80181J01	connector face gasket
18	- - - - -	control circuit board
19	30-80034K01	flex cable
20	- - - - -	display circuit board
21	61-80152L01	lightpipe
22	61-80139L01	lens
23	0702114Z01	bracket, adapter
24	0402866W01	flat washer (2)
25	0402849W01	split lockwasher (2)
26	0380114M04	M5X0.8X16 screw (2)
27	0702114Z02	bracket, adapter